

the dangers of high winds and accompanying rough seas. Indeed, it was not until the last decade of the month, or between the 22d and 30th, as gathered from numerous reports that winds of gale velocity actually occurred in the northern trans-Pacific latitudes. These included two days with gales of moderate force, a day with a fresh gale, and a fourth day with a wind of force 9, all occurring within the region 42° to 48° N., 175° E. to 170° W. This was during the period of revival of the Aleutian Low.

Tropical storm activity was of marked importance in the weather of Asiatic waters for the first time since the beginning of the year. A full report on the several typhoons that occurred there, prepared by the Rev. Miguel Selga, S. J., of the Philippine Weather Bureau, appears elsewhere in this issue of the REVIEW, and the storms therefore need no further description. It may be added however, that the typhoon which entered the China coast on the 9th and 10th and continued far inland, was probably mainly responsible for the heavy rains which caused the serious flood conditions in the Yangtse River near Hankow. Conditions attending the later typhoons of the 17th to 18th and the 24th to 26th served to aggravate the flood situation and increase the sufferings of the many thousands of homeless and hungry Chinese.

An intense cyclone was experienced on the 30th and 31st in the southeastern Pacific by the Panaman motor ship *Brunswick*, Capt. P. A. Yorgensen, observer A. Gratningsater, Sydney to Los Angeles. Said the observer:

The storm started August 30 with increasing NE. wind. At noon 30th in $18^{\circ} 00' N.$, $143^{\circ} 52' W.$, barometer 29.63 (approximate), wind NE., 8. During day gradually increasing wind and sea. At 10.11 p. m., in $18^{\circ} 33' N.$, $143^{\circ} 22' W.$, barometer dropped rapidly to 28.94 (approx.) and was ranging between 28.94 and 28.82 for about 15 minutes, while wind shifted N.-NW.; later rising barometer with wind shifting to W., SW., and S., and finally settling down on SE., where it blew out during next 24 hours. The maximum wind was from N., force 11. Temperature over 80° . Weather hazy with rain.

This is the fifth tropical cyclone known to form thus near and to the eastward of the Hawaiian Islands in the last 22 years.

While no cyclones occurred this August off the west coast of Mexico, a moderate northwest gale was experienced on the 15th in the Gulf of Tehuantepec during the existence of a depression in the Gulf of Honduras, and a local gale occurred on the morning of the 19th during a flurry at the mouth of the Gulf of California. During a 3-hour electrical storm on the 11th in $8^{\circ} 55' N.$, $85^{\circ} 07' W.$, the American steamship *K. R. Kingsbury* was reported "struck by lightning six or seven times."

Winds at Honolulu.—The prevailing wind direction at Honolulu was east, with northeast as next in frequency. The maximum velocity was 24 miles from the northeast on the 6th.

Fog.—Along the northern routes fog was slightly less frequent as a whole than in July, but was still a factor of great importance, since it occurred on 20 to 50 per cent of the days over much of the ocean between about 42° and 52° N., to the westward of about 150° W. The region of maximum occurrence here was south of the central and western Aleutians. Off the American coast between central California and the mouth of the Columbia River there was more fog than in the previous month, with a maximum of approximately 15 days on which it was observed to the northward of Eureka. South of San Francisco fog decreased sharply in occurrence to the central coast of Lower California, where reports of it ceased.

TYPHOONS OF AUGUST, 1931

By REV. MIGUEL SELGA, S. J.

[Weather Bureau, Manila, P. I.]

The first seven months of the year 1931 were unusually free from typhoons in the Philippines. The typhoon season having been delayed, there was in many regions a general complaint of lack of rain, which threatened to affect adversely the crop of rice. By the end of July the typhoon season had set in and the rains that in Manila had been 73 per cent below normal up to the end of July were 150 per cent above normal by the end of August.

The Pratas typhoon—July 29 to August 2, 1931.—The first certain indications of this typhoon are found in our weather maps of July 29, when the barometers began to fall gradually in the Philippines. The isobars of the 2 p. m., weather map of July 29 and the wind directions, which were northeast in northeastern Luzon, northwest in southern Luzon and Samar, westerly in southern Leyte, southern Samar and Surigao, south by west in Palau, and southeast in Yap, pointed to a center of a disturbance that was tentatively located within a hundred miles of 15° N. and 127° E.

On the afternoon of July 29 all ships were warned by radio, and Provinces of the islands were notified by telegraph that there was a depression over the Pacific three or four hundred miles east of Luzon. The barometric gradient at 6 a. m. on July 30 indicated that the center of the typhoon was to the east of Baler Bay. A convergence of cirrus toward the east-southeast observed at Basco at 6 a. m. is worth recording here. The usual drift of air at cirrus level in our latitudes is from the east and seems to act, as component force from the east, on the cirri radiated out from a typhoon center and at a considerable distance from the vortex. From an analysis of 37 former observations of cirrus directions in the front quadrants of typhoons, Mr. Leo G. Welch, S. J., of Manila Observatory, has found that in 19 cases the cirri were diverging exactly radially from the center, and in 15 cases the directions were less than 45° off from radial divergence, and that the lack of radial divergence could in every case be explained by a component force from the east. Three cases for unknown reasons are in apparent contradiction to the rule. Undoubtedly the convergence observed at Basco was due to the typhoon and could be taken as a fair precursory sign. All along the eastern coast of Luzon, as well as in Basco, the pressure had fallen 2 mm. from 6 a. m. of the 29th to 6 a. m. of the 30th. The center was plotted out to be near $16^{\circ} 30' N.$, $126^{\circ} 10' E.$, moving northwest by north. It continued in this direction until 2 p. m., when it was located at approximately $18^{\circ} 50' N.$, 125° E. Here it changed its course to west-northwest, due to a high pressure center over Japan which was increasing and causing the barometers to rise even in Oshima and Shanghai. Advancing in its westerly motion, the typhoon was at 6 p. m. in the center of the Balintang Channel, between Aparri and Basco.

A cablegram was dispatched to Hong Kong at 9 p. m. on July 30 to warn the colony of the sudden and dangerous turn of the typhoon. Maintaining its west-northwesterly course, the center of the typhoon passed over the Pratas shoal at 8:30 p. m., July 31, when the barometer of Pratas Observatory registered the minimum of 740.9 mm. The wind that at 5 p. m. was blowing from the north with force 7-8 dropped to a dead calm at 7:30 p. m. and remained absolutely still for two hours until 9:30 p. m.,

when it sprang from the south-southwest with force 8. In the three and a half hours immediately preceding the minimum, the barometer dropped 4.85 mm., but it gained 7.10 mm. in the two and a half hours following the barometric minimum.

Very early in the morning on August 1 precautions were taken in Hong Kong to minimize the effects of the typhoon that was threatening to strike the colony about noon. Ships sought safety in Typhoon Bay. The wind increased in force at 8 a. m. and from noon to 4 p. m. it was blowing a gale, while the typhoon was making its way to the continent between Hong Kong and Macao. The easterly gale of the afternoon blowing straight against the harbor of Hong Kong dashed the waves against the sea wall, sending volumes of spray into the air. The eastern end of Queen's Pier was badly damaged, big blocks of granite and concrete being flung into the harbor and on to the Praya. Due to the timely warnings issued by the Hong Kong Observatory, the colony escaped the blow fairly lightly. Typhoon signal No. 10 was hoisted in Hong Kong for the first time after the adoption of the new system of typhoon signals recommended by the Conference of Directors of Far Eastern Weather Services in 1930.

The Japanese steamer *Ryusei Maru* was reported in distress, having run into the center of the typhoon, 50 miles east-southeast of Hong Kong. The *President Jefferson* rode out the storm safely in Typhoon Bay, Hong Kong. Its wind veered from northeast, force 7, at 11 a. m. to southeast, force 4, at 7 p. m. Its lowest barometric reading was 743.4 mm. at noon; its strongest winds were from the east-northeast, force 11-12, at 1 p. m. Inland the typhoon weakened and seems to have filled up on August 2.

This typhoon increased in force of wind and depth of barometer from the Philippines to Hong Kong. It caused a very modest amount of rainfall, but no severe squalls, in the Philippines.

The Waishing-Kwongsang typhoon.—August 6-12, 1931.—From August 2 to 6 the weather of northern Luzon remained unsettled, with low barometer, light winds, and constant indications of shallow depressions. Our afternoon weather map of August 7 showed a typhoon at a considerable distance northeast of Aparri. It remained almost stationary or curved slowly until the afternoon of August 8, when it started off toward the north. On the afternoon of August 9, it appeared almost southeast of Ishigakijima. Pushed backward by the high pressure over Japan, the typhoon changed its course and headed off toward the northwest, passing very close to the northeast of Ishigakijima. The pressure at this station at 11 a. m. on August 9 had fallen to 739.5 mm., with north-northwest winds of force 6. Retaining its northwesterly direction, the typhoon passed 50 or 60 miles to the north of Keelung, Formosa, crossed the northern entrance of the Formosa Channel, raising mountainous seas and causing terrific winds, and entered the continent between Foochow and Wenchow in the morning of August 10. With a constantly increasing and gradual inclination to the west, the typhoon moved toward the interior of China for over 600 miles and seems to have filled up on August 12 in the Province of Kweichow.

Many ships were seriously affected by the strong winds and seas caused by this typhoon, especially along the China coast.

The *Susana II* rode out the storm in the harbor of Keelung while coaling. Her barometer dropped to 740.2

mm. on August 10 at 1 a. m., with winds from the west, force 5.

While the typhoon was crossing the northern entrance of the Formosa Channel the 5,000-ton steamer *Benarty* of the Ben Line was lashed by hurricane winds and pounded by mountainous seas for eight hours north of Swatow. "It was the worst experience of my life," said the master of the ship in reporting the terrific gale, with squalls often exceeding 100 miles an hour. The chief engineer was washed overboard by a huge wave; a lifeboat, being hurled over the side, was smashed to pieces by the power of the seas.

The 1,865-ton steamer *Waishing* of the Indo-China S. N. Co., bound from Hong Kong to Shanghai, encountered tremendous seas on August 10 after passing Foochow and, finding herself unable to battle against the elements, took refuge in Nam Kwan Bay, but, overtaken by the typhoon, the ship was driven ashore by the violence of the seas, was badly holed, and left in a precarious condition on the rocks. It is stated that the *Waishing* had hardly struck the rocks when pirates swarmed about, making off with everything they could lay their hands on. To prevent further pillage, and while waiting for the arrival of rescue ships in answer to the S O S calls, a perimeter camp had to be formed ashore, gathering the survivors on top of a small hillock and mounting guard with one revolver that had been salvaged from the wreck. One of the ships to answer the S O S call was the *Kwongsang*, of the same Indo-China S. N. Co., bound from Shanghai to Hong Kong. She seems to have been off Fu Island, just 30 miles of the Nam Kwan Bay, headed to the assistance of the *Waishing*, when she foundered after a furious battle against the typhoon. The *Kwongsang* carried 6 European officers and a crew of 56 Chinese. Bodies of many victims washed ashore, and stories of local fishermen of Fu Yan and Funingfu all point to the probability that no passenger escaped the disaster of *Kwongsang*.

Our own steamship *President Jefferson*, with many and prominent passengers on board, passed very close to the center of this typhoon on August 10 between Foochow and Wenchow and experienced winds of force 8 to 10 for over six hours.

The China Sea typhoon, August 7-20, 1931.—From August 7 to 12 a low-pressure area prevailed over the China Sea from northern Annam to Luzon. On the morning of August 13 it was evident that a well-defined center had developed in the trough of the low pressure, which had deepened considerably on the 12th. It had moved to the north of Macclesfield Bank by Friday afternoon and developed into a typhoon very early in the morning of August 15, moving north. The U. S. S. *Simpson*, laboring under heavy seas 60 miles west by south of Koshun, reported east-southeast winds of force 8 at 6 a. m. on August 15. The typhoon inclined to east-northeast, passed south and east of Pratas in the afternoon of August 15, and recurved to northwest at night approaching Bias Bay. The lowest barometric reading at Pratas was 739.80 mm. at 3 p. m. with winds from north-northeast and force 3, three hours previously the barometer read 742.09 mm., with east-northeast winds of force 6, while at 6 p. m. the wind had backed to southwest, force 4, with the barometer at 741.14 mm. For the 24 hours following August 16, 6 a. m., the typhoon moved slowly northward, passing by to the east of Hong Kong late on the night of the 16th. During the forenoon of the 17th it entered the coast of China, between Hong Kong

and Swatow. The wind at Gap Rock backed from east-northeast, force 6, at 5 p. m. on August 15, to north, force 6, at 10 p. m. and north-northwest, force 7, at 7 a. m. August 16, remaining steady from that direction until 3 a. m. August 17, increasing to force 8 at 11 a. m. August 17. Two days after the typhoon had entered China it filled up in the Provinces of Wangtung or Kiangsi.

This depression and typhoon will be memorable for the heavy rains it caused, the rough seas it excited in the China Sea, and the poor visibility it brought in.

A régime of intermittent squalls and abundant rainfall along the western coast of Luzon and in the Visaya Islands began with the typhoon preceding this one and with the low-pressure area over the China Sea out of which this typhoon developed. The winds freshened on August 7 and the following days brought squalls which were most severe at Baler, Maasin, Calbayog, Cebu, and Sorsogon. Strong winds were felt also at Batangas, Corregidor, Manila, and Baguio. Winds of force 7 were reported from Calbayog and Baler on August 10 and from Cebu on August 11, 13, and 15. Force 8 was reported from Calbayog on August 13 and 18. Many other stations reported squalls in which the wind reached force 6. A gale blowing over the China Sea built up high waves that persisted for several days. The U. S. S. *Simpson*, the U. S. S. *Chaumont*, the *Hanover*, the *Anking*, and the *Hinsang*, navigating the eastern part of the China Sea, reported very rough seas, with winds of force 6 to 8. The visibility all over the China Sea was so poor that masters of long experience in the navigation of these seas encountered considerable difficulty in making ports and sighting lighthouses. At the entrance of Corregidor the weather was so thick and the rain so blinding that one end of the ship could not be seen from the other.

The rainfall during this time was heaviest on the western coast of Luzon. Coming simultaneously with the highest tide ever experienced in Manila during the last 26 years, it caused floods in Manila and many low sections of near-by Provinces. The total rainfall in millimeters from August 7 to 15 was 579.9 in Batangas, 793.5 in Dagupan, 886.8 in Iba, and 1,036.5 in Manila. The floods of Manila and adjacent Provinces may afford occasion for another paper, when all the rainfall returns have been received.

The Pacific typhoon of August 11 to 18, 1931.—Almost simultaneously with the formation of the preceding typhoon another one was developing between the Caroline and Marianas Islands. Prescinding from its early indications shown in our weather maps from the 9th to the 11th, and omitting the uncertain movements of the typhoon up to August 14, it was not until the 15th that it had any perceptible effect on the stations in the Loochoos and Bonin Islands and could be definitely situated in about 24° latitude N. and 134° longitude E. It then moved almost west-northwest until the morning of August 16, when it inclined more to the west until the afternoon of the same day, taking afterwards a definite northwest movement until noon of the 17th. Inclining more to the west in the afternoon of August 17, it passed between Naha and Oshima over into the Eastern Sea, where it filled up.

Throughout its course this typhoon remained too far away from our archipelago to have any serious effect on our weather. As far as observations are available at present, nowhere did the barometer fall below 746 mm. under the influence of this typhoon, nor were gales experienced along its path.

The Naha Typhoon, August 14 to 28, 1931.—Probable indications of this typhoon appear in our weather maps of August 14 to 17. Originating between Guam and Yap, it moved very slowly to the north first, but it inclined to the west-northwest at 6 a. m. of the 19th. While swerving more and more to west during the next 48 hours, the barometric minimum deepened, and while the inflow of the air in front of the advancing cyclone was slight, southwesterly winds of force 4 to 6 prevailed from the Strait of San Bernardino down to the northern Mindanao. Under these conditions the U. S. Navy transport *Chaumont*, south of the storm, was fighting its way to Guam against winds of force 7. By this time the last spur of the Pacific high was receding further toward the Pacific, leaving the whole field of the Far East to the typhoon. From 6 a. m. of the 21st to 2 p. m. of the same day the typhoon moved northwest, but inclined successively north-northwest, north, north by east, and back to north until August 23. Changing its course rapidly to the west, the typhoon passed south of and very close to Naha early in the morning of August 24, causing the barometer of Naha to fall at least to 724 mm. Maintaining its westerly motion for 24 hours, the storm inclined to west-northwest, northwest, north-northwest, and north by west, heading for Shanghai.

On the evening of August 25, it struck Ningpo with the full force of a violent gale. After having crossed Hangchow Bay it inclined slightly north by east and instead of devastating Shanghai it passed east of and close to the city at about 3 a. m. on August 26. In the great commercial city, however, and along the Whangpoo River the winds were fierce, and squalls exceeded at times the velocity of 100 miles per hour. Hundreds of trees in the settlement were uprooted or broken. Untold damage was done to roof tops and frail buildings. Flood water piled high by the force of the wind passed the previous high-water record by half a foot and flooded the majority of downtown ground floors in the clubs, banks, and godowns. According to the chief engineer of the Whangpoo Conservancy Board, this excessive water level was due to strong typhoon conditions superimposed on a growing spring tide and the slight rise of the general water levels at Shanghai consequent upon the Yangtze floods. The extraordinary fact that no serious disaster occurred on the water front, in spite of the thousands of small craft and the absence of shelter for both large and small vessels, was attributed both by the harbor officials and the press to the frequent and accurate warnings of Zikawei Observatory.

The *President Cleveland* rode out the storm safely in the river. During the 12 hours following noon, August 25, she was buffeted by winds of force 9 from almost the northeast; from 2 to 4 a. m. on August 26 the wind blew from the north with force 9; from 6 a. m. to 6 p. m. it continued backing from north-northwest, force 8, to west, force 2. The lowest barometer observed on board the *President Cleveland* at 3 a. m. August 26 was 726.90 mm. The press of Shanghai reported 723.90 mm. as the lowest barometric reading during the passage of this storm and compared it with the record barometric minimum 722.40 mm. on August 28, 1915, when the Changhai typhoon destroyed several Shanghai vessels and exacted a toll of hundreds of lives. After passing Shanghai the typhoon inclined north-northeast, and, gaining speed, it moved decidedly east-northeast or northeast, crossing the Yellow Sea, northern Korea, and the whole Sea of Japan up to La Perouse Strait in 48

hours. The barometer at Nemuro fell to 741 mm. on August 28 at noon with the approach of the storm and rose to 759.5 mm. the next morning at 6 a. m. with the recession of the typhoon toward the Pacific. On the 24th and 25th this typhoon held complete and undivided sway over the whole Far East, the pressure and winds being controlled by it from southern Manchuria down to the Sulu Archipelago, over a distance of at least 2,000 miles. The steamers *President Madison*, *President Cleveland*, U. S. S. *Jason*, and U. S. S. *Parrot* were buffeted by the gales of the typhoon in the Eastern Sea.

The arrival of the *President Cleveland* with the honorable Secretary of War on board was delayed one day on account of the typhoon which the steamer encountered in the Eastern Sea. This typhoon and delay were mentioned in the proclamation of the Governor General of the Philippines transferring from August 31 to September 1 the special public holiday proclaimed on the occasion of the visit of the Secretary of War.

BUCKET OBSERVATIONS OF SEA-SURFACE TEMPERATURES

By GILES SLOCUM

STRAITS OF FLORIDA AND CARIBBEAN SEA

Table 1 shows the average temperatures for the Caribbean Sea and the Straits of Florida for August of each year from 1919 to 1930, inclusive, and Table 2 summarizes the temperature for August, 1930, in the same areas. The chart shows the number of observations taken in August, 1930, within each 1° square and mean temperature data for subdivisions of the areas considered.

For more detailed information regarding the methods of treating data, see the January, 1931, issue of the MONTHLY WEATHER REVIEW.

After remaining nearly stationary through much of July, the mean surface temperature of the Caribbean Sea rises throughout August, but at a rate somewhat less marked than during the spring and early summer weeks. In each of the 12 years treated (1919-1930) August has been warmer than July of the same year, and the August 11-year mean temperature (1920-1930) for each of the 5° subdivisions of the Caribbean is higher than that for the same area in July.

August is the warmest month in the Straits of Florida, and there is practically no variation of the mean temperature from one quarter month to the next, the 11-year average for each of the quarters of August being 83.9°.

The local distribution of temperatures remains much the same as in July. The straits are usually warmer than

any portion of the Caribbean, the western Caribbean warmer than the eastern, and the northern warmer than the southern except at the eastern extremity.

The differences from east to west are, however, less regularly progressive from lower temperature to higher than in July, and the average temperature is practically at a common level in all portions of the southern Caribbean except in the relatively cool central section.

The August, 1930, temperatures were above average in the Straits of Florida and the northern and extreme eastern Caribbean Sea and close to or below average in the southern Caribbean. The sea as a whole was, for the sixth consecutive month, warmer than the average.

TABLE 1.—Mean sea-surface temperatures in the Caribbean Sea and the Straits of Florida for August, 1919-30

Year	Caribbean Sea		Straits of Florida	
	Number of observations	Mean temperature	Number of observations	Mean temperature
1919 ¹	87	82.6	20	83.8
1920.....	157	81.4	47	82.5
1921.....	280	81.6	91	83.4
1922.....	192	81.5	70	84.0
1923.....	315	81.3	87	83.1
1924.....	318	82.5	121	84.9
1925.....	494	82.3	116	84.3
1926.....	491	82.9	142	84.1
1927.....	502	82.8	211	84.8
1928.....	566	82.6	166	84.0
1929.....	716	82.3	205	83.2
1930.....	589	82.5	153	84.3
Mean (1920-1930).....		82.2		83.9

¹ Not used in computations because of insufficient data available.

TABLE 2.—Mean sea-surface temperatures (°F.) and number of observations, August, 1930

Quarter	Period	Caribbean Sea				Straits of Florida			
		Number of observations	Mean	Departure from 11-year mean (1920-1930)	Change from preceding month	Number of observations	Mean	Departure from 11-year mean (1920-1930)	Change from preceding month
First.....	Aug. 1-7.....	136	°F.	°F.	°F.	87	°F.	°F.	°F.
Second.....	Aug. 8-15.....	143	82.1	-----	-----	41	84.2	-----	-----
Third.....	Aug. 16-23.....	153	82.3	-----	-----	38	84.2	-----	-----
Fourth.....	Aug. 24-31.....	157	82.8	-----	-----	37	84.6	-----	-----
	Month.....	589	82.9	-----	-----	153	84.2	-----	-----
			82.5	+0.3	+0.5		84.3	+0.4	+1.3